

APPLICATION OF STRIPS OF SLURRY  
VIA A MOVING BELT ANGLED TO THE  
DIRECTION OF FLOW OF A PAPER WEB

Background of the Invention

5                   This invention relates to a method and  
apparatus for treating paper with material in  
repetitive patterns. More particularly, the invention  
relates to a method and apparatus whereby these  
repetitive treatment patterns can be applied without  
10 contact between the paper and the apparatus.

                  It is well known in the papermaking art that  
it is desirable to have the capability to alter or  
enhance the characteristics of paper. For instance,  
cigarette manufacturers have long appreciated the  
15 usefulness of adding flavorings or burn control  
additives to paper. Another more recent application  
that has been identified concerns altering cigarette  
paper so that smoking articles incorporating the  
altered paper will have a reduced burn rate when the  
20 smoking article is not drawn on by the smoker; but have  
the same feel, taste and burn when drawn on by the  
smoker at normal intervals.

                  Cigarette wrappers, i.e., papers, have burn  
characteristics, including burn rates and static burn  
25 capabilities. It is known that burn characteristics  
can be modified by adding fillers, coatings, or  
additives to papers. Copending, commonly-assigned  
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includes a description of many of these methods, and also discloses a nonlaminated paper of variable basis weight and suggests that burn rate control of this paper can be achieved economically with mass-  
5 production techniques. The variable basis weight is achieved by applying bands of slurry in a pattern to a moving paper web during production while leaving regions of the paper between the pattern untreated. Additional slurry increases the basis weight of the  
10 paper in treated regions, and when the paper is incorporated in a smoking article, the smoking article has a decreased burn rate in these regions. Although many methods are known for treating paper with material in patterns, limitations of these methods render them  
15 less effective for altering the basis weight of cigarette paper in patterns.

For example, many techniques have been developed for imprinting or coating paper webs. These include gravure presses, blade coating, roller coating,  
20 silkscreening and stenciling methods. Bogardy U.S. Patent No. 4,968,534 describes a stenciling apparatus wherein a continuous stencil comes into facing engagement with a paper web during the application procedure. The apparatus includes a preparation step  
25 where air is evacuated from the web through the pattern stencil prior to the application step in order to facilitate the treatment procedure. The pattern applied by the device can be altered by changing the stencil used.

30 The apparatus of Bogardy U.S. Patent No. 4,968,534 is typical of many of the other previously known treatment devices because the apparatus contacts the paper web during the application process. These previously known devices, as a result,  
35 can only be used at points in the papermaking process

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where the paper is sufficiently stable to withstand the contact. This limits flexibility in placement of these devices, because the devices cannot be incorporated in a papermaking machine at relatively early stages of the  
5 papermaking process.

Stenciling and other previously known methods generally transfer a predetermined pattern to a treated article. The only way to change the pattern applied is to replace the pattern-forming element of the device.  
10 In other words, there is no easy way to alter the pattern by, for instance, merely changing operating parameters. This characteristic particularly limits the applicability of these devices in mass-production situations where it is desirable to apply several  
15 patterns to paper being produced.

Another characteristic of previously known devices like that of Bogardy U.S. Patent No. 4,968,534 is that the amount of material applied cannot be varied appreciably. In essence, since the devices are in  
20 contact with the web, there must be penetration of the web by the material during the application procedure for significant amounts of material to be applied to the web. The required penetration may not be possible depending on the combined characteristics of the paper  
25 and the treatment material, thereby resulting in less than optimum treatment of the paper.

A particular limitation of devices like that of Bogardy U.S. Patent No. 4,968,534 is that a stenciling device incorporating a pattern for applying  
30 relatively-closely spaced bands of narrow width to cigarette paper would experience flexure of the stencil and resultant pattern non-uniformity when scaled to the size of a papermaking machine of the type used to make cigarette paper.

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A final characteristic of previously known devices is that in order to maintain sufficient pressure, a sump of treatment material is positioned above the stencil. This solution generally requires  
5 that sump material be recirculated to a reservoir. This constant recirculation of unused treatment material may allow contamination of the treatment material.

It would be desirable to provide a method and  
10 apparatus for treating paper webs which can be easily incorporated into present papermaking machines.

It would be desirable to provide a method and apparatus for treating paper webs without contact between the paper web and the apparatus.

15 It would be desirable to provide a method and apparatus for applying chemical treatments to paper webs in patterns wherein the pattern applied can be altered by changing machine operating parameters.

It would be desirable to provide a method and  
20 apparatus for treating paper webs where the pattern applied can also be altered by replacing the pattern forming element of the apparatus.

It would be desirable to provide a method and apparatus for applying material to moving paper webs  
25 where the amount of material applied can be varied appreciably.

It would be desirable to provide a method and apparatus for applying material to moving paper webs in uniform patterns.

30 It would be desirable to provide a method and apparatus for applying material to moving paper webs where the amount of material being applied can be accurately metered, eliminating the need for recirculation of treatment material.

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It would further be desirable to provide a method and apparatus for applying chemical treatments to cigarette paper so that burn rate control can be achieved economically with mass production techniques.

5 Summary Of The Invention

Accordingly, it is an object of the present invention to provide a durable moving orifice applicator which can be inexpensively manufactured and easily incorporated into a papermaking machine at  
10 various points in the papermaking process.

Another object of the present invention is to provide a moving orifice applicator which selectively applies material in a pattern to a paper web without contacting the moving paper web.

15 Another object of the present invention is to provide a method for treating a paper web where the pattern applied to the web can be changed by altering machine operating parameters.

Another object of the present invention is to  
20 provide a method for treating a paper web where the pattern applied to the paper web can be changed by replacing a pattern-forming element.

Another object of this invention is to provide a moving orifice applicator in which the amount  
25 of material applied to the paper web can be varied appreciably.

Another object of the present invention is to provide an application method in which a large quantity of web is treated with material in uniform patterns, in  
30 a continuous manner, and at high speeds.

Another object of the present invention is to provide an application method where the amount of material being applied can be accurately metered.

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Briefly described, the invention comprises an apparatus and method for applying material to paper in a repetitive pattern for the purpose of altering the characteristics of the paper. Although the preferred  
5 embodiment describes use of the invention for producing paper with variable burn characteristics, it is expected that the invention could apply many different materials to achieve differing paper characteristics. For instance, the invention can apply compounds which  
10 are detectable by electromagnetic means, thus allowing the paper made to be used in security situations. The invention could also be used to apply dyes, inks, or flavorings.

In the preferred embodiment, the apparatus of  
15 this invention, a moving orifice applicator, is mounted on a paper making machine directly over the Fourdrinier wire between the wet line and the couch roll. The applicator consists of continuous steel belt mounted on motor-driven pulleys. The lower traverse of the belt's  
20 travel forms the bottom of an enclosed cavity. Perforations on the centerline of the belt are in communication with the cavity. The plane of the lower traverse of the belt is parallel to the plane of the web, and the direction of belt travel is at an angle to  
25 the direction of web travel. During operation, slurry is continuously pumped into the enclosed cavity and motion of the belt across the web causes parallel bands of slurry to be applied to the web as slurry passes from the cavity through the perforations and onto the  
30 web. The relative angle of bands applied to the web with respect to the web and their spacing can be easily changed by altering the relative angle and speed of the belt and web without having to change the belt as in previously known devices. The width of bands can be  
35 changed by altering the application pressure of the

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slurry without having to change the pattern belt as in previously known devices.

In an alternate embodiment of the invention the moving orifice applicator can be incorporated in a machine to treat finished, dry paper. This embodiment includes a drying means to facilitate the drying of bands applied to the web.

In other alternate embodiments of the invention, the pattern-forming element of the apparatus contains patterns of perforations of either varying sizes or spacings with the result that the pattern applied consists of a repetitive sequence of bands of varying sizes or spacings.

#### Brief Description Of The Drawings

The above and other objects and advantages of this invention will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1 is a perspective view of a papermaking machine incorporating the present invention;

FIG. 2 is a vertical cross-sectional view of a moving orifice assembly in accordance with the invention, taken along line 2-2 of FIG. 1;

FIG. 3 is a partially fragmentary perspective view of the cavity block assembly of the moving orifice assembly of FIG. 2;

FIG. 4 is a perspective view of an alternative embodiment of the invention;

FIG. 5 is a schematic view of an alternative embodiment of the invention; and

FIG. 6 is a schematic view of an alternative embodiment of the invention.

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### Detailed Description of the Invention

The present invention relates to a method and apparatus for altering the characteristics of paper by treating the paper during or after the production process. With this invention many different paper characteristics can be achieved. For example, materials that confer distinctive characteristics upon the paper, such as compounds which are detectable by electromagnetic means, could be applied with the invention. Inks, dyes or flavorings could also be applied with the invention. The invention could also be used to apply a pattern of flavor generating material, or a pattern of electrically conductive, resistive or insulating material, for use in a flavor generating article such as that disclosed in commonly assigned U.S. Patent No. 5,060,671. Although the first preferred embodiment of the invention relates to treatment of cigarette paper, those skilled in the papermaking art will realize that the invention has many applications.

The first preferred embodiment of the invention concerns a method and apparatus for altering the basis weight of cigarette paper in select regions so that the burn rate characteristics are altered in these regions. As used herein, "base web" relates to untreated regions of paper and "cross-directional regions" are the regions of increased basis weight in the cross-direction of web travel. These "cross-directional regions" are achieved by applying "bands" of slurry in an "application pattern."

An increase in basis weight may be achieved by providing a paper with localized regions of either (1) increased thickness or (2) increased density, or both. The increase in basis weight may be accomplished

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by depositing, onto an existing pulp web in a  
papermaking machine, additional material such as a  
second quantity of cellulosic pulp, or, alternatively,  
a filler material. Some examples of additional  
5 materials are highly refined cellulosic pulp, high  
surface area cellulosic fibers such as cellulon,  
microcrystalline cellulose such as Avicel or a mixture  
of highly refined pulp and calcium carbonate. Other  
insoluble, cellulose-compatible materials could also be  
10 used, such as amylopectin or certain modified  
celluloses.

The cross-directional regions made with this  
invention preferably have a basis weight above that of  
the base web. When paper made with the present  
15 invention is incorporated in a smoking article, the  
smoking article has variable burn rate characteristics.  
For example, the static burn rate of the smoking  
article is substantially decreased in the cross-  
directional regions. The regions of increased basis  
20 weight have decreased porosity. The rate of oxygen  
diffusion through the paper in these regions is thereby  
decreased, retarding combustion of the smoking article.

The dimensions of the cross-directional  
regions will also affect the burn characteristics of  
25 the paper and, consequently, the smoking article. In  
particular, the width of the cross-directional regions  
exerts a substantial effect on the burn rate, and the  
greater the separation between cross-directional  
regions, the faster a smoking article made from the  
30 paper will burn.

The present invention provides a method and  
apparatus for applying slurry in an application pattern  
to form the cross-directional regions. The method and  
apparatus of this invention allow the application  
35 pattern to be changed by adjustment of machine

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operating parameters, thereby altering the spacing and width of the cross-directional regions comprising the application pattern. This allows the same machine to make papers with differing variable burn rate

5 characteristics. The pattern-forming element of the invention can also be replaced. This allows the apparatus of this invention to apply patterns consisting of bands of varying widths or spacings.

The first preferred embodiment of the  
10 apparatus of this invention is shown in FIG. 1 which depicts the pulp web-forming area of a conventional Fourdrinier papermaking machine 1, adapted to produce a continuous pulp web 2. A headbox 3 contains a quantity of cellulosic pulp which is supplied to headbox 3 by a  
15 plurality of conduits 4 which communicate with a pulp source (not shown). A common pulp source is a pulp storage tank, which is not shown.

Immediately below headbox 3 is an endless forming wire 5. A slice 6 defined in a lower portion  
20 of headbox 3 adjacent to wire 5 permits the pulp from the headbox to flow through slice 6 onto the top surface of the wire 5 to form pulp web 2. Slice 6 is usually of narrow vertical width in order to regulate the amount of pulp which flows from headbox 3. The  
25 length of slice 6 extends substantially the entire width of pulp web 2.

The top portion of wire 5 is adapted to move forwardly toward a couch roll 7 and away from slice 6. The direction from headbox 3 toward couch roll 7 is the  
30 downstream direction. Once the pulp web has been formed, it passes under the apparatus of this invention, a moving orifice applicator 8, which deposits additional material onto the pulp web 2. This material forms the cross-directional regions which  
35 comprise the application pattern. From FIG. 1 it is

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apparent that the moving orifice applicator 8 does not contact the pulp web 2 during the application procedure.

As shown to better advantage in FIG. 2, the moving orifice applicator 8 consists in part of a continuous moving belt 9, which preferably is made of steel. The continuous moving belt 9 is mounted on a main drive wheel 10 and main idler wheel 11. The main drive wheel may be driven for rotation by any suitable means (not shown).

The moving orifice applicator 8 has a main frame 12 composed of an I-beam. The main frame 12 could be constructed of cast aluminum. Welded at both ends of frame are brackets 13. These brackets support the main idler wheel 11 and main drive wheel 10.

The main frame 12 has a top flange 14. The top flange 14 supports the fixed idler wheel yoke 15. The fixed idler wheel 16 is mounted in the fixed idler wheel yoke 15. Also mounted on the top flange 14 is the tension pivot yoke 17. The tension yoke 18 is pivotally mounted on the tension pivot yoke 17. The tension wheel 19 is mounted on the tension yoke 18. The axis of the tension wheel 19 and fixed idler wheel 16 can be adjusted by handles 20. This adjustment is necessary so that the continuous moving belt 9 can be steered. Welded steel belts have a tendency to pull to one side or the other. Adjustment of the fixed idler wheel 16 and tension wheel 19 axes by means of the handles 20 ensures that the continuous moving belt 9 tracks properly. The tension yoke 18 also pivots on tension pivot yoke 17. This is adjustable by handle 21. Adjustment of handle 21 alters the tension of the continuous moving belt 9, thereby reducing belt slippage. Handle 21 also

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relieves tension to facilitate replacement of the continuous moving belt 9.

Mounted to the bottom flange 22 of frame 12 is the cavity block assembly 23. The cavity block assembly 23 retains the slurry to be applied to the pulp web during the application procedure. Slurry is supplied under pressure to the cavity block assembly 23 from a slurry supply source (not shown) through a plurality of inlets 24.

The particulars of the cavity block assembly 23 are shown to better advantage in FIG. 3. The cavity block assembly 23 has a cavity block 25 which encloses an interior cavity 26 on five sides. The cavity block 25 does not enclose the bottom of the cavity 26. Instead a shield 27 and a portion of the lower traverse 28 of the continuous moving belt 9 enclose the bottom of the cavity 26. The continuous moving belt 9 has a plurality of perforations 29 disposed along its center line 30. These perforations 29 are in communication with the cavity 26 during a portion of the lower traverse 28 of the continuous moving belt 9. The continuous moving belt 9 passes through a slot 31 formed by the shield 27 and the cavity floor 32. In order to ensure that the perforations 29 in the continuous moving belt 9 remain in communication with the cavity 26, the shield has a slot 33 machined along its center line. This slot 33 allows the perforations 29 in the continuous moving belt 9 to remain in communication with the cavity 26, while minimizing the amount of slurry in the cavity 26 which contacts the continuous moving belt 9. This is necessary because an unshielded continuous moving belt would have a greater pumping effect on the slurry. This pumping effect is exhibited by a displacement of slurry in the cavity in the direction of travel of the continuous moving belt.

If this effect were not minimized through the use of a shield, the application pattern might be less uniform.

As the perforations 29 in the continuous moving belt 9 come into communication with the cavity 26 in the cavity block assembly 23 during the lower traverse 28 of the continuous moving belt 9, slurry which has been supplied to the cavity block assembly 23 is forced out through the perforations 29 and onto the pulp web 2. The motion of the each perforation 29 across the pulp web 2 causes a series of bands 34 to be applied to the pulp web 2. These bands 34 constitute the cross-directional regions of the application pattern.

Referring again to FIG. 1, the application pattern 35 formed on the moving paper web consists of a series of equally spaced bands 34, each band 34 being of equal width, and each band perpendicular to web travel. The moving orifice applicator 8 is mounted so that the direction of the lower traverse 28 of the continuous moving belt 9 is at an angle to the direction of travel of the pulp web 2. Accordingly, for the moving orifice applicator 8 to create bands 34 perpendicular to web travel, the lower traverse 28 of the continuous moving belt 9 must have a velocity component in the direction of travel of the pulp web 2 which is equal to the velocity of the pulp web 2.

The orientation of the bands applied to the moving pulp web with respect to the moving pulp web can be altered. For instance, if it is desired that the bands be at an angle to web travel, instead of perpendicular, this can be easily accomplished by changing the relationship of the velocity component of the continuous moving belt 9 in the direction of the pulp web 2 and the velocity of the pulp web 2. As long as they are equal, the bands 34 applied will be

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perpendicular to web travel. If a differential is introduced, then the bands 34 applied will be at an angle to web travel.

One feature of the invention is that the  
5 spacing of the bands can be changed without having to replace the pattern-forming element of the apparatus. In the present invention this is accomplished by changing the angle of the lower traverse 28 of the continuous moving belt 9 while maintaining the  
10 component of velocity of the continuous moving belt 9 in the direction of web travel equal to the velocity of web travel. This will ensure that the bands 34 applied remain perpendicular to web travel. This angle change is accomplished by altering the pivots 36.

15 Another feature of the invention is that the width of bands applied to the moving pulp web 2 can be increased by increasing the application pressure of the material. This is accomplished by increasing the pressure of slurry supplied to the cavity block  
20 assembly 23.

An additional feature of the invention is that the amount of material applied to each individual band can easily be increased by decreasing the component of velocity of the continuous moving belt 9  
25 perpendicular to the direction of travel of the moving pulp web 2. In order to maintain a perpendicular application pattern, the velocity of the moving pulp web 2 will have to be decreased.

After the moving orifice applicator 8 has  
30 applied the application pattern 35 to the moving pulp web 2, the web continues to move in a downstream direction. As wire 5 begins to move downwardly about couch roll 7 and back toward headbox 3, pulp web 2 is delivered from wire 5 to a plurality of press rolls 37  
35 and then to a dryer section of papermaking machine.

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(not shown). As pulp web 2 advances in the downstream direction, excess water is permitted to pass through wire 5. A vacuum 38 typically may be applied to at least a portion of the underside of wire 5 to assist in the removal of water from pulp web 2. Couch roll 7 may be adapted to provide a vacuum through wire 5 to the underside of pulp web 2 to remove additional water.

In an alternate embodiment of the invention shown in FIG. 4, the moving orifice applicator 8 has been incorporated in a machine 39 to treat paper that has already been made. The machine has a roll of premanufactured paper 40 mounted on a feed shaft 41. The paper on the roll 40 is fed between an upper idler 42 and a lower idler 43 and onto a continuous moving web 44. A continuous moving web may not be needed, depending on paper strength. For example, the paper may be supported by a shoe (not shown) familiar to those skilled in the art. The moving orifice applicator 8 is mounted above the continuous moving web 44 which is supporting the paper 45 to be treated. After the application pattern 35 has been applied to the paper 45 by the moving orifice applicator 8, the paper moves underneath a drying means 46. A number of drying means familiar to those skilled in the art including felt absorption, heated drums and infrared drying may be used. After the application pattern 35 has been dried by the drying means 46, the paper moves between the final upper idler 47 and final lower idler 48. The paper 45 is then taken up by a take-up roll 49 mounted on the take-up shaft 50.

In other alternate embodiments of the invention it may be desirable to apply bands of material of varying widths or spacings. This may be true whether the paper web being treated has just been

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made or is premanufactured. FIGURES 5 and 6 and show how this may be accomplished.

In FIG. 5 the lower traverse 28a of the continuous moving belt 9a is shown in schematic form from above. The continuous moving belt 9 of the first preferred embodiment with its perforations of equal size and spacing has been replaced with a continuous moving belt 9a having perforations 29a of equal size but varying spacing, the spacing repeating in sequence. In this particular embodiment, the component of velocity of the lower traverse 28a of the continuous moving belt in the direction of travel of the moving pulp web 2 is the same as the velocity of the moving pulp web 2 so that bands 34a comprising the application pattern 35a are perpendicular to the direction of travel of the moving pulp web 2.

As shown by FIG. 5 the varying spacing of the perforations 29a of the continuous belt 9a is repeated in the application pattern 35a which consists of a series of bands 34a of varying spacing, the spacing repeating in sequence. Since the continuous moving belt 9a is mounted at an angle to web travel, the actual separation of the bands applied is less than the spacing of the perforations 29a.

FIG. 6 shows how the size of bands applied can be varied. Again the lower traverse 28b of the continuous moving belt 9b is shown from above in schematic form, the lower traverse 28b located directly above the moving pulp web 2. The continuous moving belt of the first preferred embodiment with its perforations of equal size and spacing has been replaced with a continuous moving belt 9b having perforations 29b of equal spacing but varying sizes. Again the component of velocity of the lower traverse 28b of the continuous moving belt 9b is the

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same as the velocity of the moving pulp web 2 so that bands 34b comprising the application pattern 35b are perpendicular to the direction of travel of the moving pulp web 2. As shown by FIG. 6 the sequence of  
5 perforations of varying sizes in the continuous moving belt 9b is repeated in the application pattern 35b which consists of a series of bands 34b of varying sizes, the sizes repeating in sequence.

One skilled in the art will appreciate that  
10 the present invention can be practiced by other than the described embodiments, which are presented for purposes of illustration and not of limitation, and the present invention is limited only by the claims that follow.

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What is claimed is:

1. A method of applying a material to a paper web, comprising the following steps:

(a) moving said paper web along a first path;

(b) moving a plurality of perforations in sequence along a second path, said second path including a second path portion which crosses said first path; and

(c) discharging said material through said perforations and onto said paper web as said perforations travel along said second path portion.

2. A method of applying a material to a paper web, comprising the following steps:

(a) moving said paper web at a first velocity along a first path in a direction of travel;

(b) moving a plurality of perforations in sequence along a second path at a second velocity, said second path including a second path portion which crosses said first path at an angle, said second path portion located directly above said first path; and

(c) discharging said material under pressure through said perforations onto said paper web located directly below said perforations as said perforations travel along said second path portion, said perforations in said second path portion forming an application pattern on said paper web comprising a series of bands of said material, said bands being substantially parallel.

3. The method of claim 2, wherein said perforations are of substantially equal size, whereby said bands forming said application pattern are of substantially equal size.

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4. The method of claim 2, wherein said perforations moving in sequence are of substantially equal spacing, whereby said bands forming said application pattern are of substantially equal spacing.

5. The method of claim 2, wherein said perforations moving in sequence are arranged in a repetitive pattern of varying sizes, whereby said bands forming said application pattern are arranged in a repetitive pattern of varying sizes.

6. The method of claim 2, wherein said perforations moving in sequence are arranged in a repetitive pattern of varying spacings, whereby said bands forming said application pattern are arranged in a repetitive pattern of varying spacings.

7. The method of claim 2, wherein a component of said second velocity of said perforations in said direction of travel of said paper web is equal to said first velocity of said paper web, so that said bands forming said application pattern are perpendicular to said direction of travel of said paper web.

8. The method of claim 2, wherein a component of said second velocity of said perforations in said direction of travel of said paper web is different from said first velocity of said paper web, so that said bands forming said application pattern are at an oblique angle to said direction of travel of said paper web.

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9. The method of claim 2, wherein widths of said bands forming said application pattern are altered by changing said pressure of said material.

10. The method of claim 2, wherein amount of said material applied to said bands is varied by altering a component of said second velocity of said perforations perpendicular to said direction of travel of said paper web.

11. The method of claim 2 comprising the further step of applying a vacuum to said paper web after said material has been applied to said paper web.

12. The method of claim 2 comprising the further step of drying said paper web after said material has been applied to said paper web.

13. The method of claim 2, wherein said material comprises a slurry applied in said application pattern to alter burn rate characteristics of said paper web.

14. A method of applying a material to a paper web moving at a first velocity in a direction of travel, comprising the following steps:

(a) driving a continuous moving belt located above said paper web and extending across width of said paper web at a second velocity, said continuous moving belt out of contact with said paper web, said continuous moving belt having an inner surface and an outer surface, said continuous moving belt having a plurality of perforations disposed in a pattern along extent of said continuous moving belt, said pattern described by size and spacing of said perforations,

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said continuous moving belt having a lower traverse during which said perforations in said continuous moving belt move across said paper web, plane of said lower traverse parallel to plane of said paper web, and said lower traverse crossing said paper web at an angle to said direction of travel of said paper web;

(b) supplying said material under pressure to said inner surface of a portion of said continuous moving belt forming said lower traverse of said continuous moving belt;

(c) discharging said material supplied to said portion of said continuous moving belt through said perforations located in said lower traverse and onto said paper web located directly below said lower traverse, as said perforations in said lower traverse move across said paper web, said perforations in said lower traverse forming an application pattern on said paper web comprising a series of bands of said material, said bands being substantially parallel.

15. The method of claim 14, wherein said perforations forming said pattern are of substantially equal size, whereby said bands forming said application pattern are of substantially equal size.

16. The method of claim 14, wherein said perforations forming said pattern are of substantially equal spacing, whereby said bands forming said application pattern are of substantially equal spacing.

17. The method of claim 14, wherein said pattern comprises a plurality of perforations of varying sizes, said sizes of said perforations repeating in sequence, whereby said bands forming said

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application pattern are of varying sizes and said varying sizes of said bands repeating in sequence.

18. The method of claim 14, wherein said pattern comprises a plurality of perforations of varying spacings, said spacings of said perforations repeating in sequence, whereby said bands forming said application pattern are of varying spacings, said varying spacings of said bands repeating in sequence.

19. The method of claim 14, wherein a component of said second velocity of said continuous moving belt in said direction of travel of said paper web is equal to said velocity of said paper web, whereby said bands forming said application pattern are perpendicular to said direction of travel of said paper web.

20. The method of claim 14, wherein a component of said second velocity of said continuous moving belt in said direction of travel of said moving paper web is different from said first velocity of said moving paper web, whereby said bands forming said application pattern are at an oblique angle to said direction of travel of said moving paper web.

21. The method of claim 14, wherein spacing of said bands forming said application pattern is altered by changing said angle of said lower traverse of said continuous moving belt relative to said direction of travel of said moving paper web.

22. The method of claim 14, wherein widths of said bands forming said application pattern are altered by changing said pressure of said material.

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23. The method of claim 14, wherein amount of said material applied to said bands is varied by altering a component of said second velocity of said continuous moving belt perpendicular to said direction of travel of said paper web.

24. The method of claim 14 comprising the further step of applying a vacuum to said paper web after said material has been applied to said paper web.

25. The method of claim 14 comprising the further step of drying said paper web after said material has been applied to said paper web.

26. The method of claim 14, wherein said material comprises a slurry applied in said application pattern to alter burn rate characteristics of said paper web.

27. A moving orifice applicator for applying a material to a moving paper web, while said moving paper web passes underneath said moving orifice applicator, comprising:

a continuous moving belt having an inner and an outer surface, said continuous moving belt having a plurality of perforations, said continuous moving belt having a lower traverse, said lower traverse of said continuous moving belt located above said moving paper web, said lower traverse at an angle to direction of travel of said moving paper web, and said continuous moving belt moving at a velocity;

a drive means for driving said continuous moving belt at said velocity;

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an holding means for holding said material above said lower traverse of said continuous moving belt, said inner surface of said continuous moving belt forming bottom of said holding means so that said material is expelled only through said perforations in said continuous moving belt and onto said moving paper web;

a supply means for supplying said material under pressure to said holding means.

28. The moving orifice applicator of claim 27 wherein said angle of said lower traverse of said continuous moving belt is variable.

29. The moving orifice applicator of claim 27 wherein said pressure of said material supplied by said supply means is variable.

30. The moving orifice applicator of claim 27 wherein said velocity of said continuous moving belt is variable over a range of velocities.

31. The moving orifice applicator of claim 27 wherein said perforations are of substantially equal size.

32. The moving orifice applicator of claim 27 wherein said perforations in said continuous moving belt are arranged in a repetitive pattern of varying sizes.

33. The moving orifice applicator of claim 27 wherein said perforations are of substantially equally spacing along said continuous moving belt.

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34. The moving orifice applicator of claim 27 wherein said perforations are spaced along said continuous moving belt in a repetitive pattern of varying spacings.

35. The moving orifice applicator of claim 27 wherein said perforations are disposed along a centerline of said continuous moving belt.

36. The moving orifice applicator of claim 27 wherein tension of said continuous moving belt is adjusted by a tensioning means.

37. The moving orifice applicator of claim 27 wherein said continuous moving belt is steered by a steering means.

38. A moving orifice applicator for applying a material to a moving paper web, while said moving paper web passes underneath said moving orifice applicator, comprising:

- a frame with two ends, with two brackets disposed at said ends of said frame, one of said brackets holding a drive wheel and second of said brackets holding an idler wheel;

- a means for driving said drive wheel;

- a continuous moving belt having an inner surface and an outer surface, said continuous moving belt having a plurality of perforations, said inner surface of said continuous moving belt mounted on said drive wheel and said idler wheel, said continuous moving belt having a lower traverse, said lower traverse passing directly above said moving paper web, plane of said lower traverse parallel to plane of said moving paper web, direction of motion of said lower

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traverse at an angle to direction of motion of said moving paper web, said drive wheel driving said continuous moving belt at a constant velocity so that said perforations in said lower traverse of said continuous moving belt pass across width of said moving paper web;

a cavity block located above said moving paper web and inside traverse of said continuous moving belt, said cavity block enclosing a cavity on five sides with bottom of said cavity exposed, said bottom of said cavity block enclosed by a portion of said inner surface of said continuous moving belt during said lower traverse of said continuous moving belt, said cavity block having a plurality of inlets for admitting said material to said cavity, said perforations in said portion of said lower traverse of said continuous moving belt forming said bottom of said cavity block in communication with said cavity so that said material in said cavity is discharged through said perforations and onto said moving paper web;

a means for guiding said portion of said lower traverse of said continuous moving belt which forms bottom of said cavity block;

a means for supplying said material to said plurality of inlets in said cavity block under pressure.

39. The apparatus of claim 38 wherein said guide means comprises a shield and a cavity floor, said shield and said cavity floor mounted below said cavity block, said shield positioned above said portion of said continuous moving belt which forms said bottom of said cavity block, said shield substantially covering said continuous moving belt except for a slot in said shield, said slot aligning with said perforations in

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said continuous moving belt so said perforations remain in communication with said cavity, said cavity floor positioned below said portion of said continuous moving belt which forms said bottom of said cavity block, said cavity floor substantially covering said continuous moving belt except for a slot in said cavity floor, said slot in said cavity floor aligning with said perforations in said continuous moving belt, said shield and said cavity floor forming a guide wherein said continuous moving belt passes.

40. The moving orifice applicator of claim 38 wherein said angle of said lower traverse of said continuous moving belt is variable.

41. The moving orifice applicator of claim 38 wherein said pressure of said material supplied by said supply means is variable.

42. The moving orifice applicator of claim 38 wherein said constant velocity of said continuous moving belt is variable over a range of velocities.

43. The moving orifice applicator of claim 38 wherein said perforations are of substantially equal size.

44. The moving orifice applicator of claim 38 wherein said perforations in said continuous moving belt are arranged in a repetitive pattern of varying sizes.

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45. The moving orifice applicator of claim 38 wherein said perforations are substantially equally spaced along said continuous moving belt.

46. The moving orifice applicator of claim 38 wherein said perforations are spaced along said continuous moving belt in a repetitive pattern of varying spacings.

47. The moving orifice applicator of claim 38 wherein said perforations are disposed along a centerline of said continuous moving belt.

48. The moving orifice applicator of claim 38 wherein tension of said continuous moving belt is adjusted by a tensioning means.

49. The moving orifice applicator of claim 38 wherein said continuous moving belt is steered by a steering means.

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Abstract Of The Disclosure

This invention relates to the treatment of paper with material in repetitive patterns. The treatment patterns made with this invention can be  
5 altered by changing apparatus operating parameters.

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DECLARATION AND POWER OF ATTORNEY

We: Edwin L. Cutright, citizen of the United States of America, G. Robert Scott, citizen of the United States of America, and Howard W. Vogt, Jr., citizen of the United States of America residing and having post office addresses at: 2713 Ridgeview Road, Powhatan, Virginia 23139, 13381 Drakewood Road, Midlothian, Virginia 23113, Route 2, Box 134, Providence Forge, Virginia 23140, declare:

that we verily believe ourselves to be the original, first and joint inventors of the invention or discovery in:

APPLICATION OF STRIPS OF SLURRY  
VIA A MOVING BELT ANGLED TO THE  
DIRECTION OF FLOW OF A PAPER WEB

which is described and claimed in the attached specification and for which a patent is sought;

that we have reviewed and do understand the content of said specification, including the claims, and acknowledge our duty to disclose information, of which we are aware, which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a);

that we do not know and do not believe that this invention or discovery was ever known or used in the United States of America before our invention or discovery thereof, or patented or described in any printed publication in any country before our invention or discovery thereof, or more than one year prior to this application; or in public use or on sale in the United States of America more than one year prior to this application; that this invention or discovery has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by us or our legal represent-

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atives or assigns more than twelve months prior to this application; and that no application for patent or inventor's certificate on this invention or discovery has been filed in any country foreign to the United States of America by us or our legal representatives or assigns;

and we hereby appoint James E. Schardt, Esq., Reg. No. 23,033, Charles E. B. Glenn, Esq., Reg. No. 29,796, Charles B. Smith, Esq., Reg. No. 16,763, Albert E. Fey, Esq., Reg. No. 19,018, W. Edward Bailey, Esq., Reg. No. 30,994, our attorneys, with power of substitution, and with power of appointment of associate attorneys, and of revocation of their powers, to prosecute this application and any divisions, continuations in whole or in part, renewals and reissues of the same, and to transact all business in the Patent and Trademark Office connected therewith; and we request that communications be sent to:

David M. O'Neill, Esq.  
c/o Fish & Neave  
875 Third Avenue  
New York, New York 10022-6250

and that telephone calls be directed to:

David M. O'Neill, Esq.  
(212) 715-0600.

Wherefore, we pray that Letters Patent be granted to us for the invention or discovery described and claimed in the attached specification and claims, and we hereby subscribe our names to the foregoing specification and claims, declaration, and power of attorney.

We declare, further, that we understand the English language and that all statements made herein of our own knowledge are true, and that all statements made on information and belief are believed to be true;

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and, further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

\_\_\_\_\_  
Date

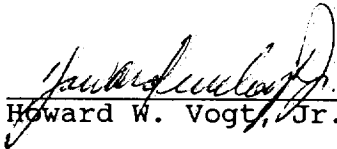
\_\_\_\_\_  
Edwin L. Cutright

\_\_\_\_\_  
Date

\_\_\_\_\_  
G. Robert Scott

2-24-92

\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Howard W. Vogt, Jr.

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A S S I G N M E N T

WHEREAS, we, Edwin L. Cutright, G. Robert  
Scott and Howard W. Vogt, Jr., residing respectively at

**REDACTED**

**REDACTED**

**REDACTED**

have

made an invention in:

APPLICATION OF STRIPS OF SLURRY  
VIA A MOVING BELT ANGLED TO THE  
DIRECTION OF FLOW OF A PAPER WEB

and are about to make application for United States  
Letters Patent therefor; and

WHEREAS, PHILIP MORRIS INCORPORATED, a  
corporation organized and existing under the laws of  
the State of Virginia and having an office and place of  
business at 120 Park Avenue, New York, New York 10017,  
is desirous of acquiring the entire interest in said  
invention for the United States, in said United States  
patent application, and in any United States Letters  
Patent which may issue thereon; and

WHEREAS, PHILIP MORRIS PRODUCTS INC., a  
corporation organized and existing under the laws of  
the State of Virginia and having an office and place of  
business at 3601 Commerce Road, Richmond, Virginia  
23234, is desirous of acquiring the entire interest in  
said invention outside of the United States, in any  
foreign patent applications, and in any foreign Letters  
Patent which may issue thereon;

NOW, THEREFORE, be it known that for and in  
consideration of the sum of One Dollar (\$1.00) to each  
of us paid and other good and valuable consideration,  
the receipt and sufficiency of which is hereby  
acknowledged;

1. We do hereby sell, assign and transfer  
unto the said PHILIP MORRIS INCORPORATED, its  
successors, assigns and legal representatives, all  
right, title and interest in and to said invention and

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any improvements thereon for the United States, and in and to said United States patent application, including any continuations and divisions thereof, and any substitute applications therefor and all right, title and interest in and to any United States patent which may issue thereon and any reissues of the same; and we hereby authorize and request competent authorities to grant and issue any and all patents on said invention in the United States to the said PHILIP MORRIS INCORPORATED as the assignee of the entire United States interest therein.

2. We do hereby sell, assign, and transfer unto the said PHILIP MORRIS PRODUCTS INC., its successors, assigns and legal representatives, all right, title and interest in and to said invention and any improvements thereon for all foreign countries, including the right to claim priority under the International Convention based on said United States patent application, and all right, title and interest in and to every foreign patent application filed or to be filed on said invention in any foreign country, including renewals, revivals, continuations and divisions thereof, and any substitute applications therefor, and any and all patents which may issue thereon, and any reissues and extensions of the same; and we hereby authorize and request competent authorities to grant and issue any and all patents on said invention in any foreign country to the said PHILIP MORRIS PRODUCTS INC. as the assignee of the entire foreign interest therein.

We further agree to execute upon request of the assignees such additional documents, if any, as are necessary and proper to secure patent protection on said invention throughout all countries of the world,

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and to otherwise give full effect to and perfect the rights of the assignees under this Assignment.

IN TESTIMONY WHEREOF, we have hereunto signed our names and affixed our seals on the dates indicated hereinafter:

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
Edwin L. Cutright

COMMONWEALTH OF VIRGINIA )  
                                  : ss.:  
CITY OF RICHMOND            )

On this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_,  
appeared before me in person the above-named Edwin L.  
Cutright and acknowledged the above to be his signature  
and that he signed, sealed and delivered the above  
instrument as his voluntary act and deed, and for the  
uses and purposes therein set forth.

\_\_\_\_\_  
Notary Public

(Notarial seal)

My Commission Expires:  
\_\_\_\_\_

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\_\_\_\_\_  
(Date)

\_\_\_\_\_  
G. Robert Scott

COMMONWEALTH OF VIRGINIA )  
: ss.:  
CITY OF RICHMOND )

On this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_,  
appeared before me in person the above-named G. Robert  
Scott and acknowledged the above to be his signature  
and that he signed, sealed and delivered the above  
instrument as his voluntary act and deed, and for the  
uses and purposes therein set forth.

\_\_\_\_\_  
Notary Public

(Notarial seal)

My Commission Expires:  
\_\_\_\_\_

2-24-92  
(Date)

Howard W. Vogt, Jr.  
Howard W. Vogt, Jr.

COMMONWEALTH OF VIRGINIA )  
: ss.:  
CITY OF RICHMOND )

On this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_,  
appeared before me in person the above-named Howard W.  
Vogt, Jr. and acknowledged the above to be his  
signature and that he signed, sealed and delivered the  
above instrument as his voluntary act and deed, and for  
the uses and purposes therein set forth.

\_\_\_\_\_  
Notary Public

(Notarial seal)

My Commission Expires:  
\_\_\_\_\_

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FIG. 1

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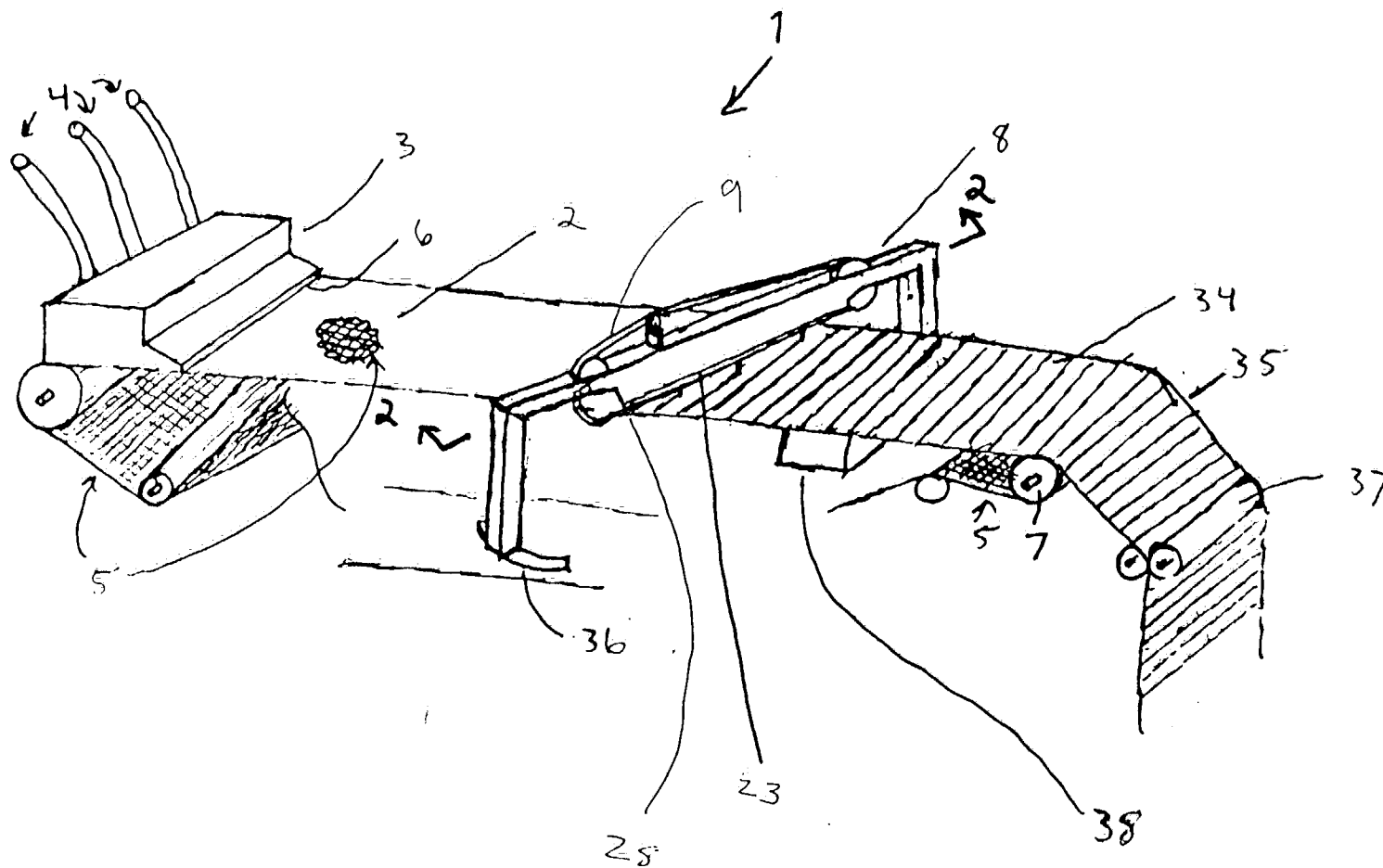
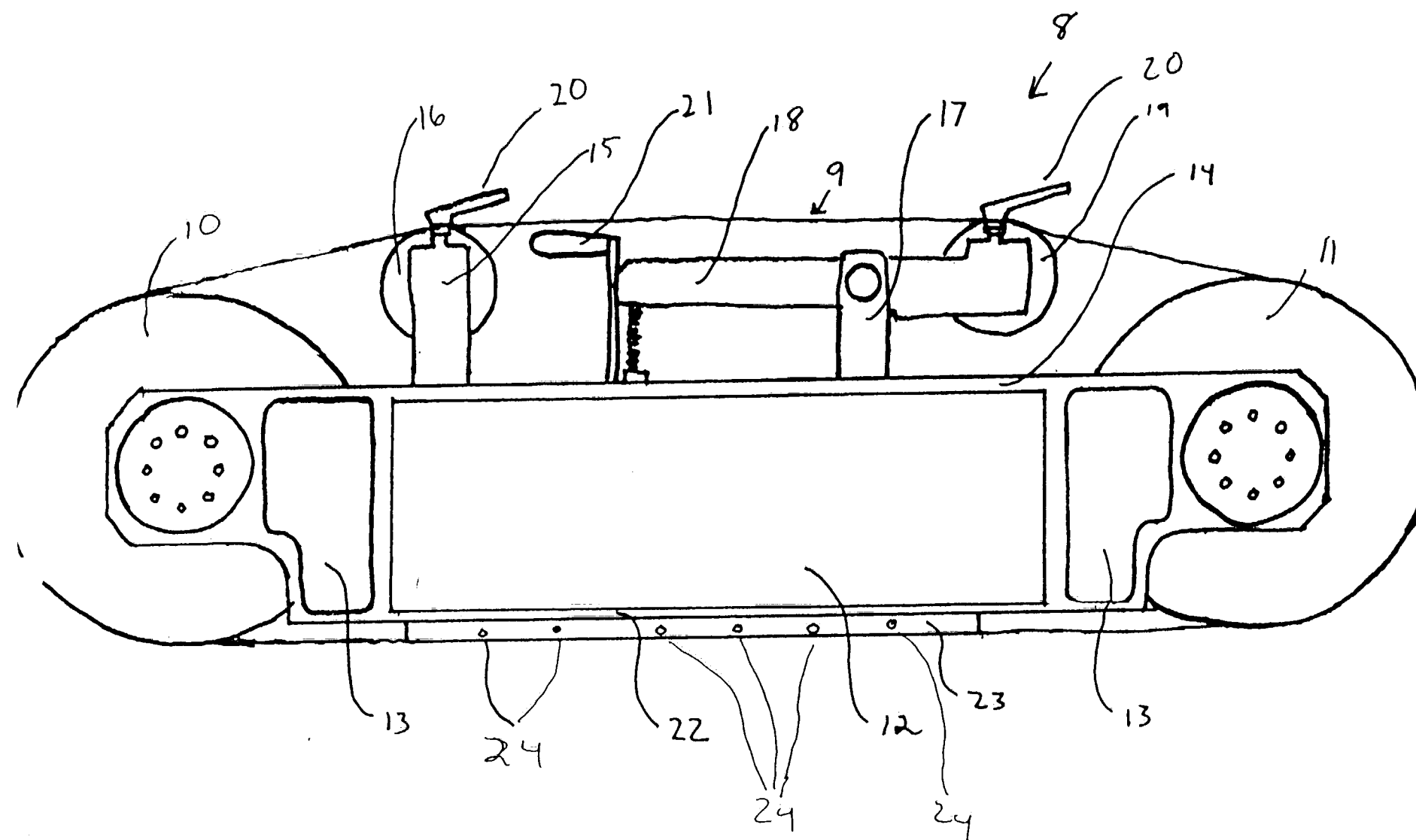


FIG. 2

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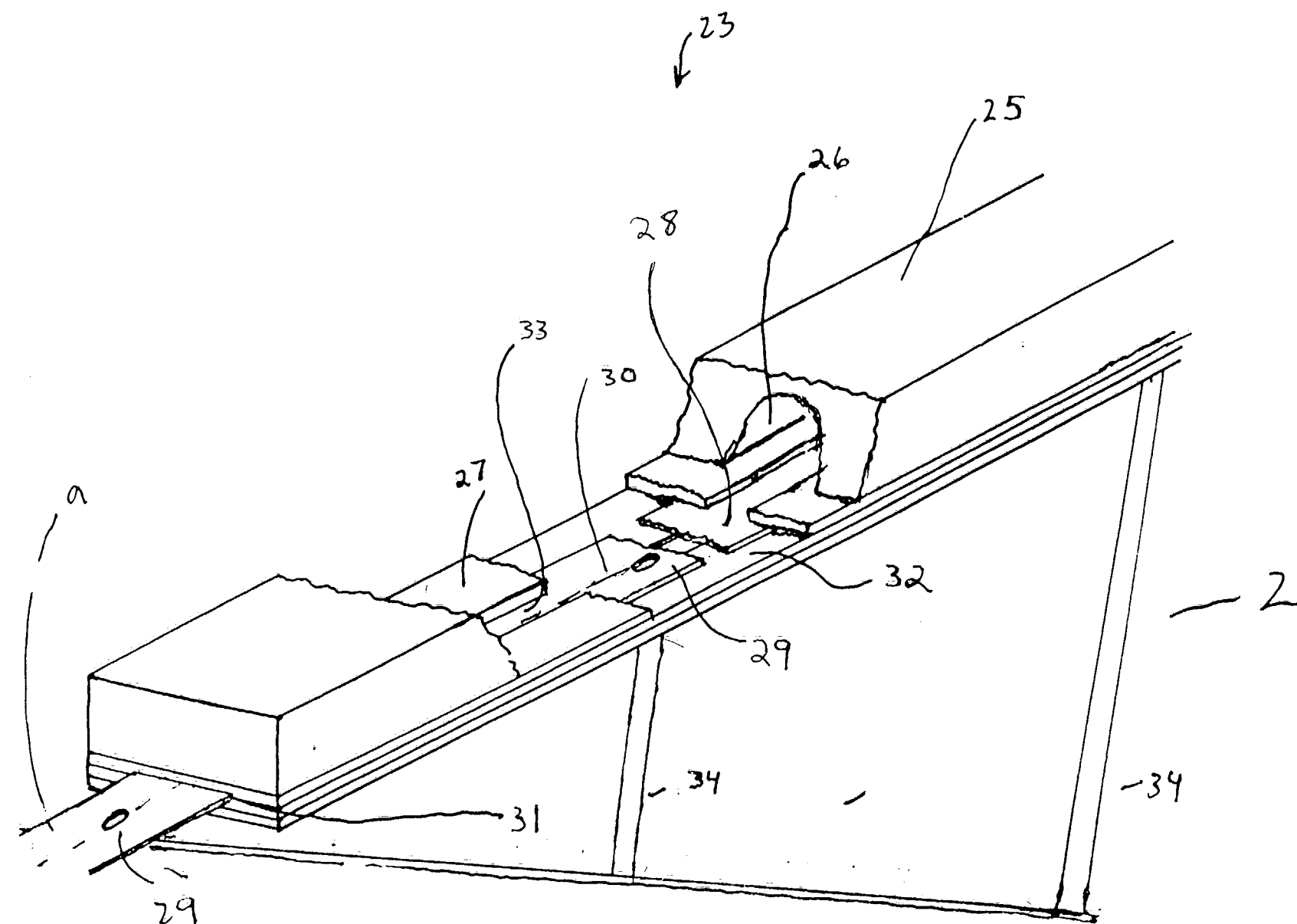
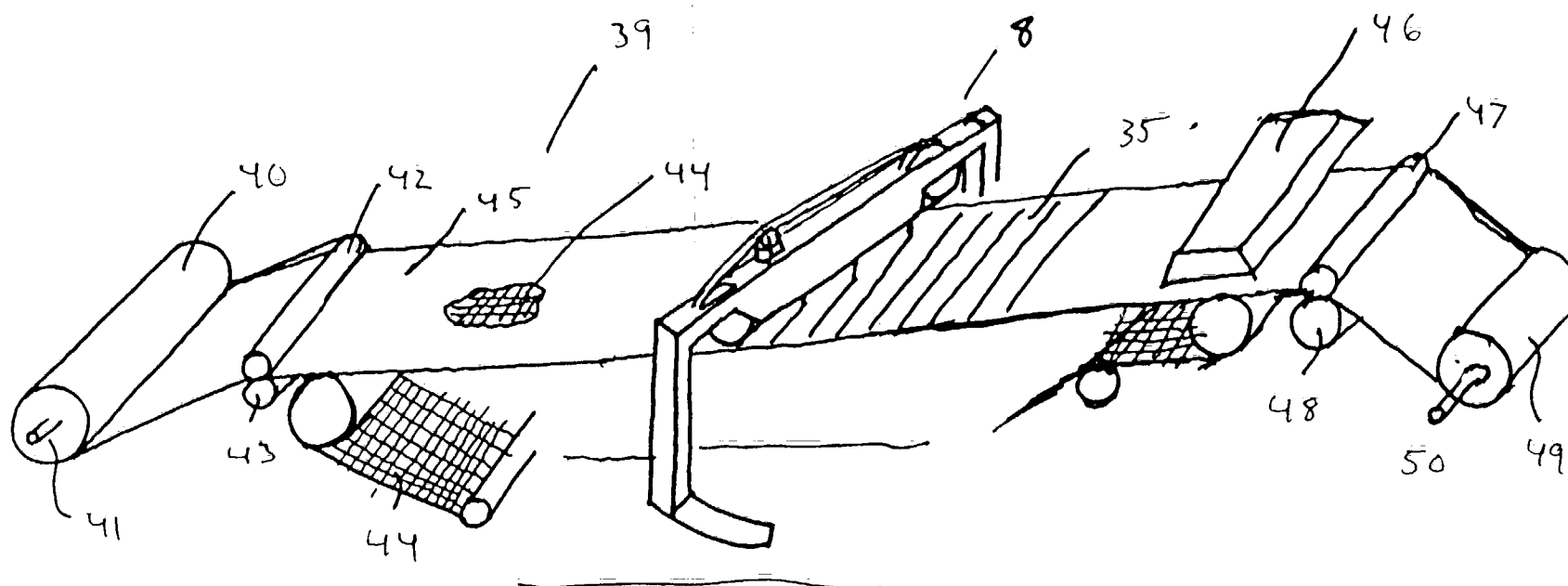


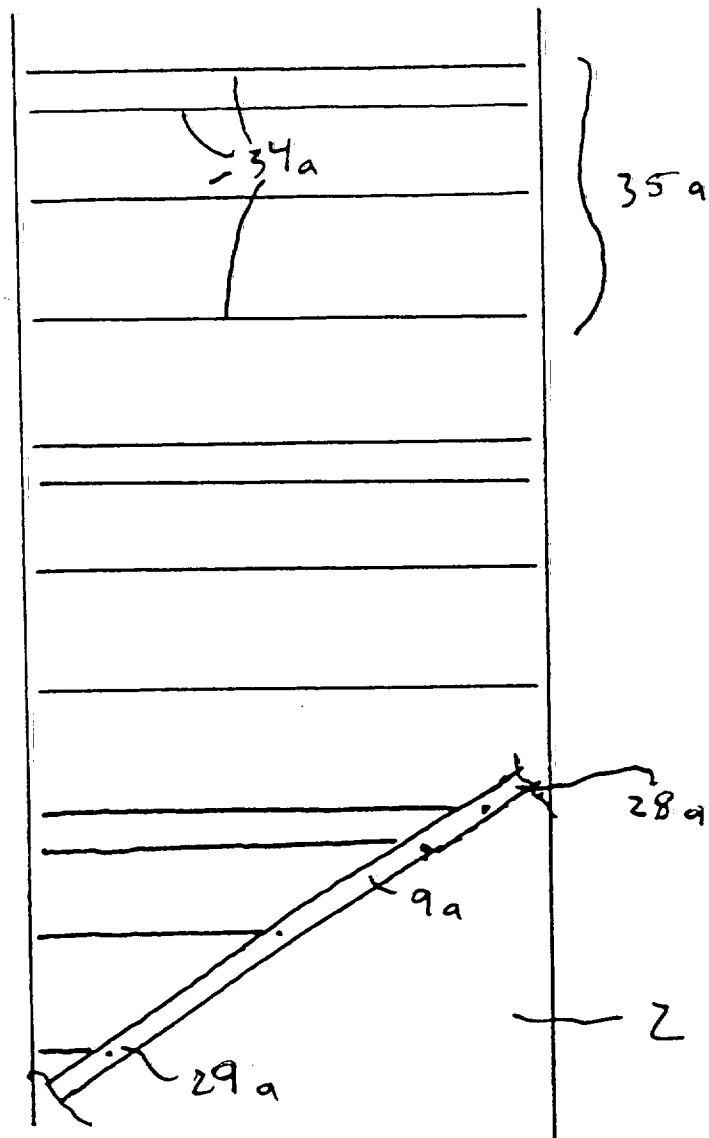


FIG. 4

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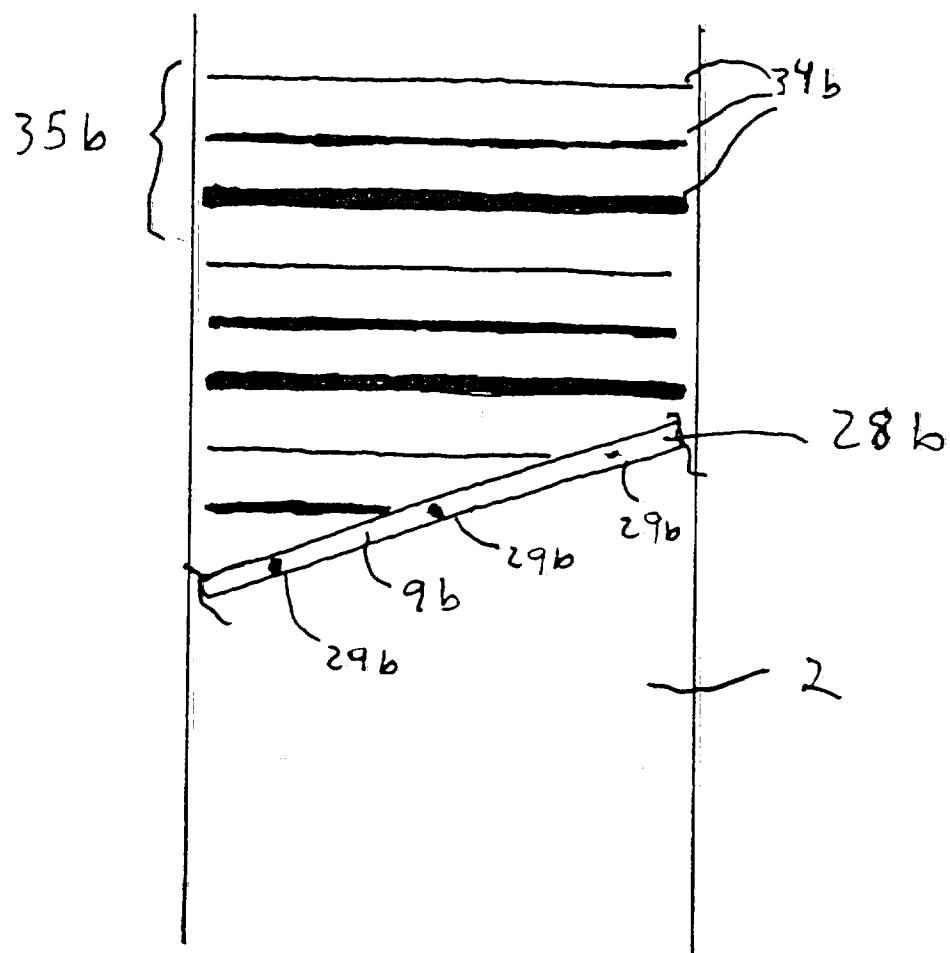


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FIG. 6



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